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(54) **METHOD FOR DETECTING ENVIRONMENTAL VALUE IN ELECTRONIC DEVICE AND ELECTRONIC DEVICE**

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(58) **Field of Classification Search**
None
See application file for complete search history.

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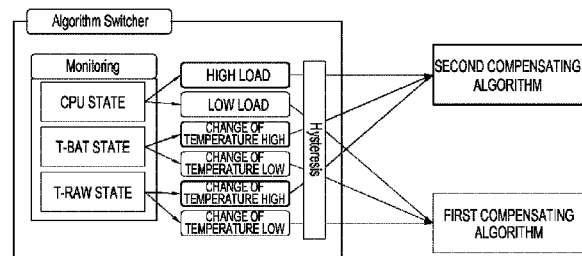
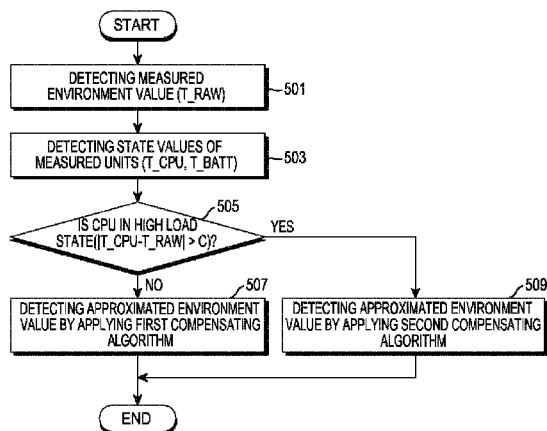
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(57) **ABSTRACT**

A method of detecting an environment vale of an electronic device is provided. The method includes measuring a state of one or more units related to the electronic device, determining a value based at least in part on the measured state of the one or more units related to the electronic device, determining an operation state of the electronic device according to the value, and generating an approximated environment value according to the operation state. Further, other various embodiments are available.

18 Claims, 9 Drawing Sheets



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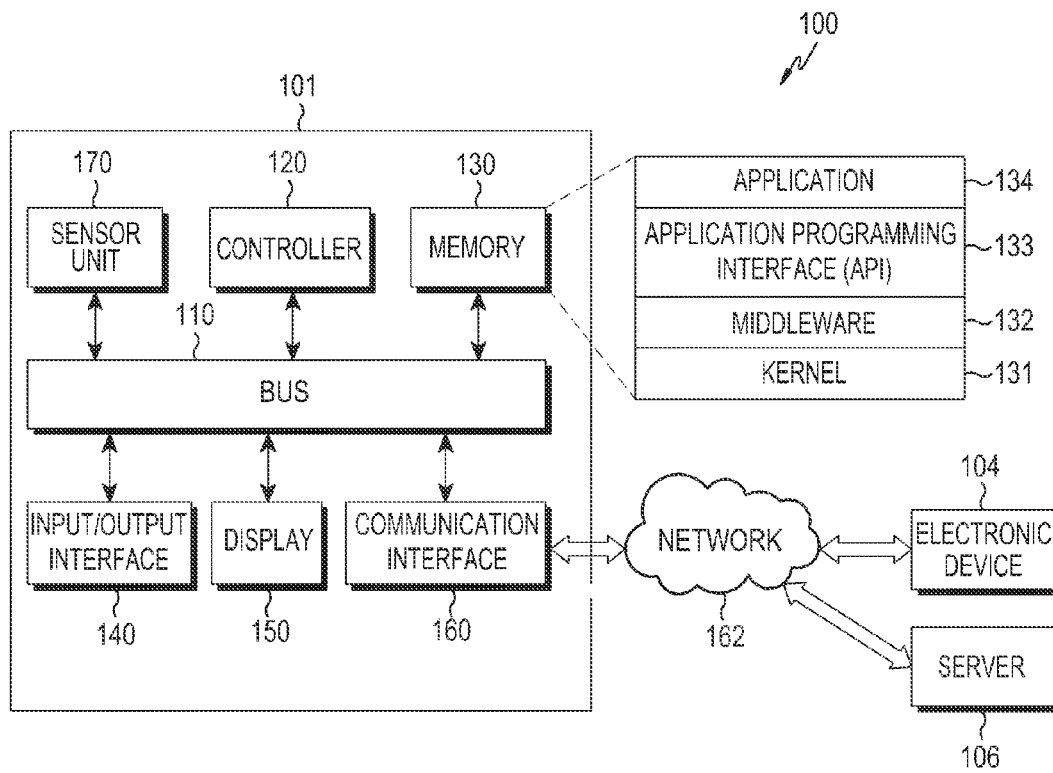


FIG.1

	T_RAW	T_BATT
Idle	30.3 → 28.9 (DECREASE:1.4)	30.5 → 29.1 (DECREASE:1.4)
Music play	28.9 → 30.7 (INCREASE:1.8)	29.3 → 31.3 (INCREASE:2)
Game	29.2 → 33.1 (INCREASE:3.9)	29.6 → 34.6 (INCREASE:5)

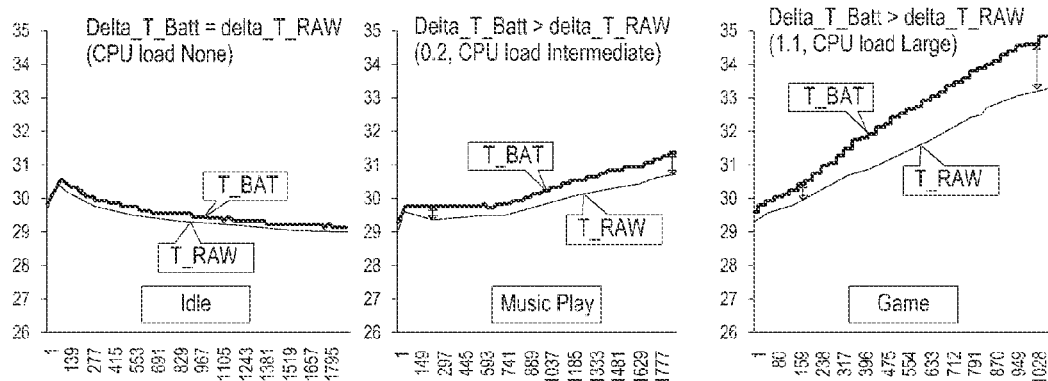


FIG.2

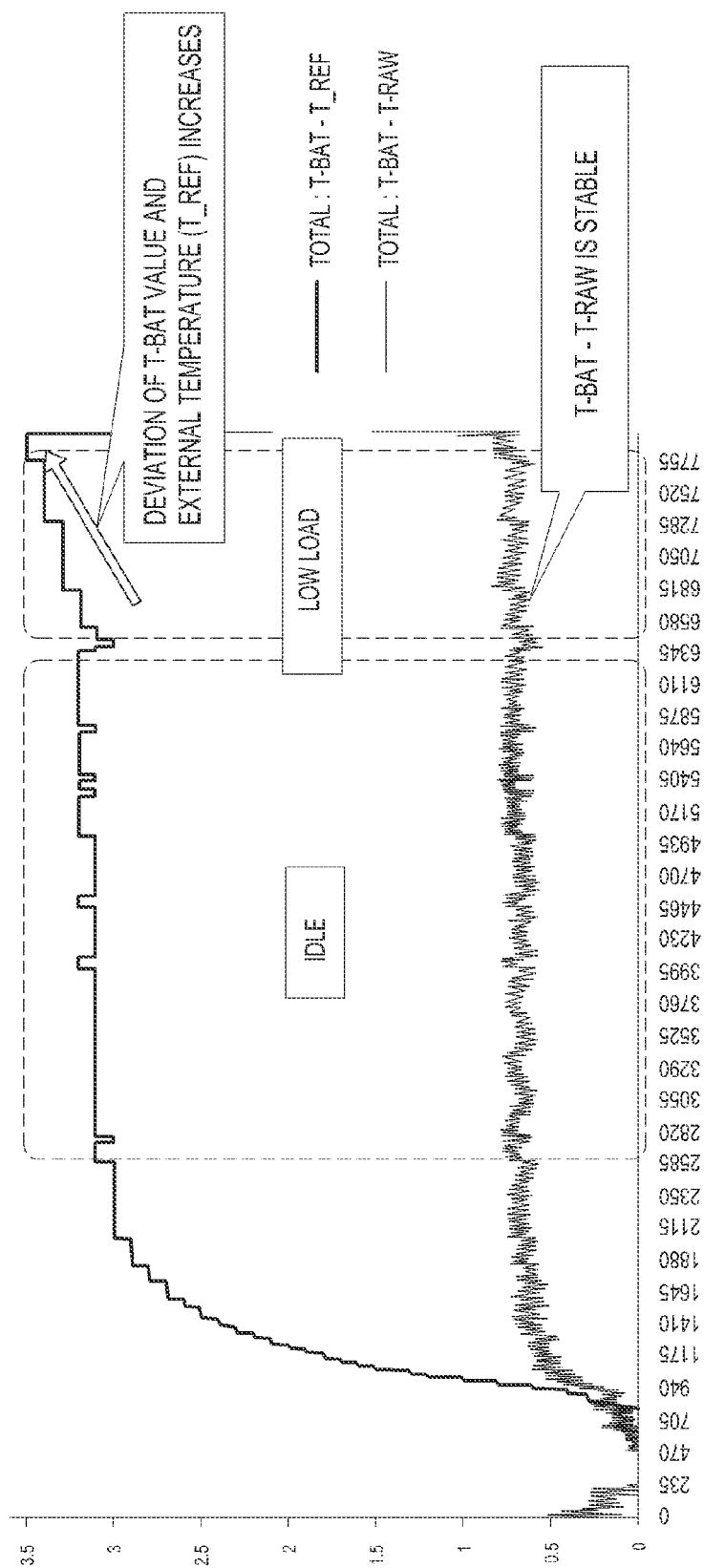


FIG.3

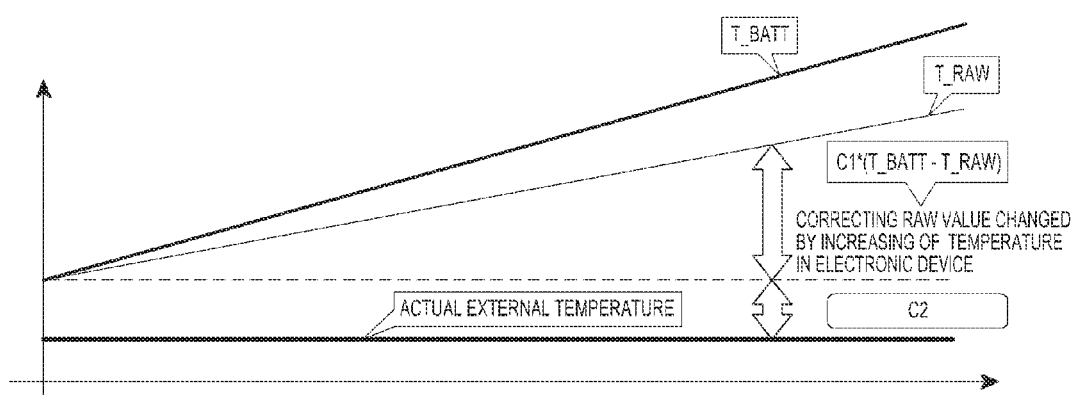


FIG.4

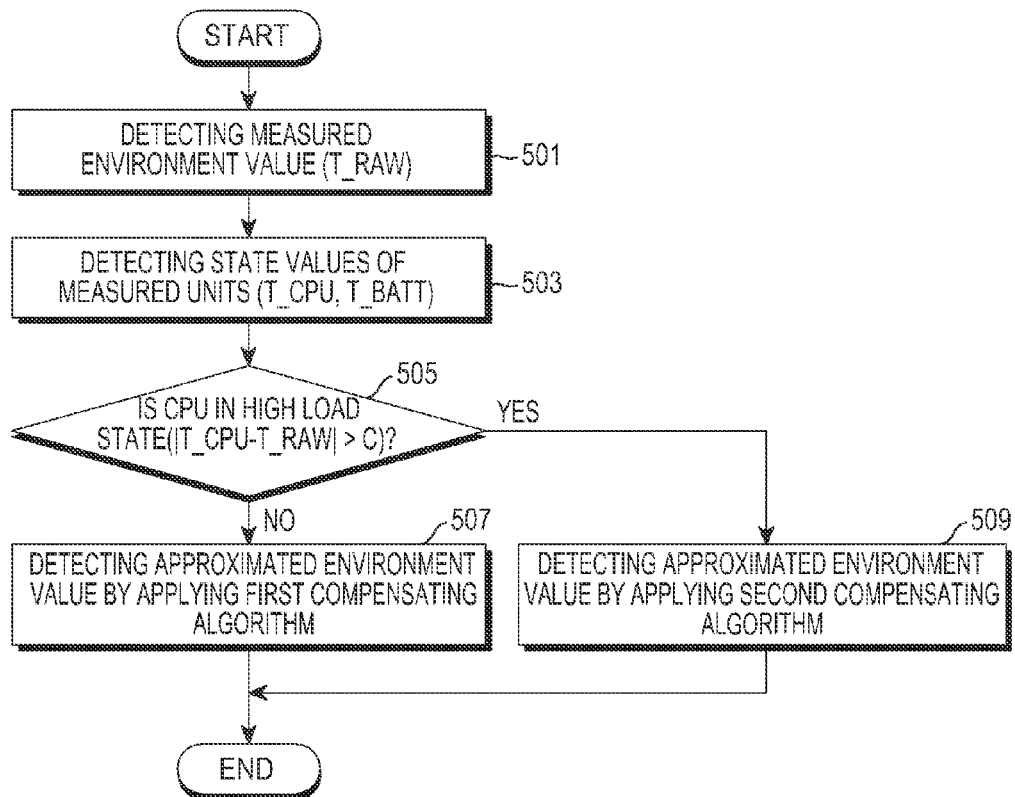


FIG. 5

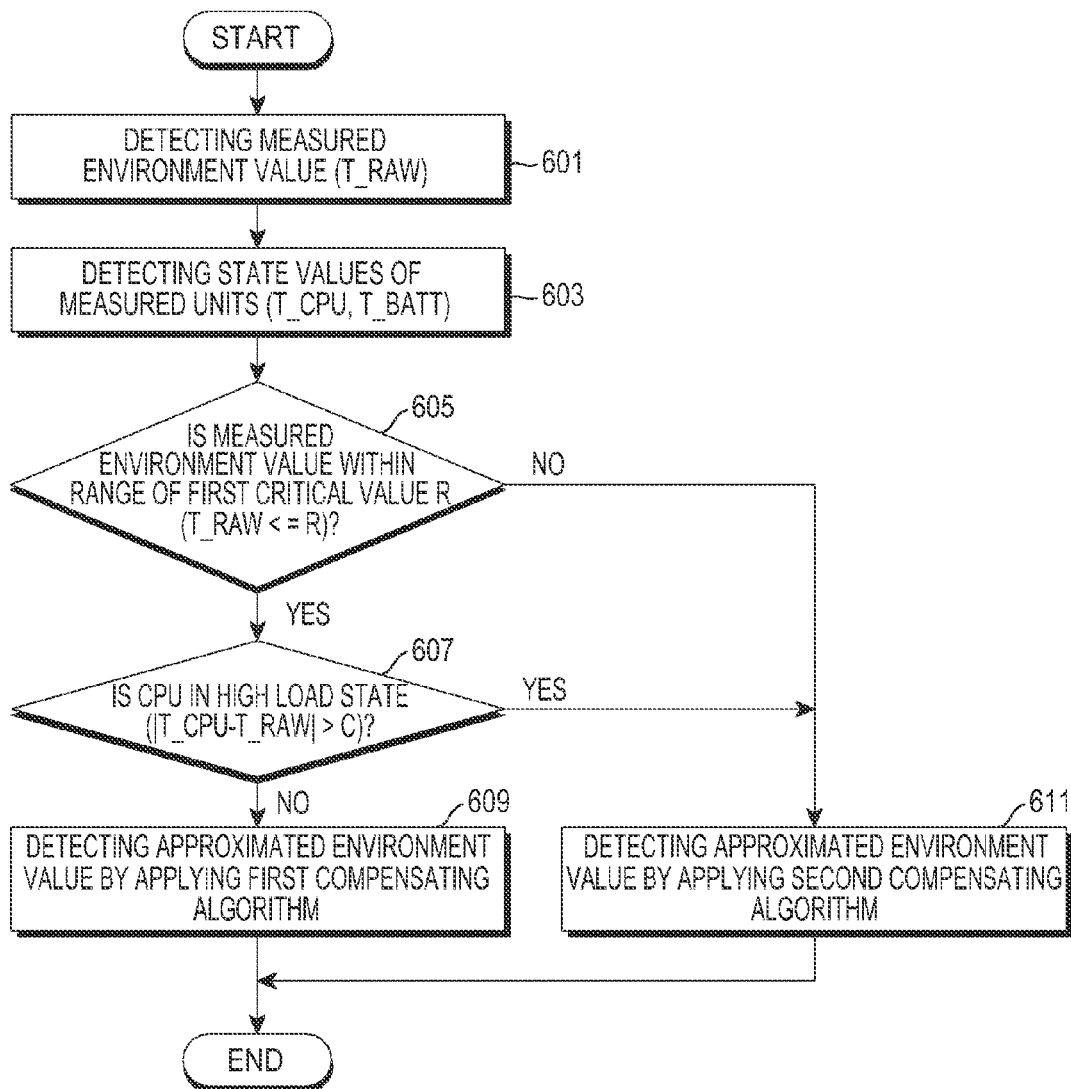


FIG. 6

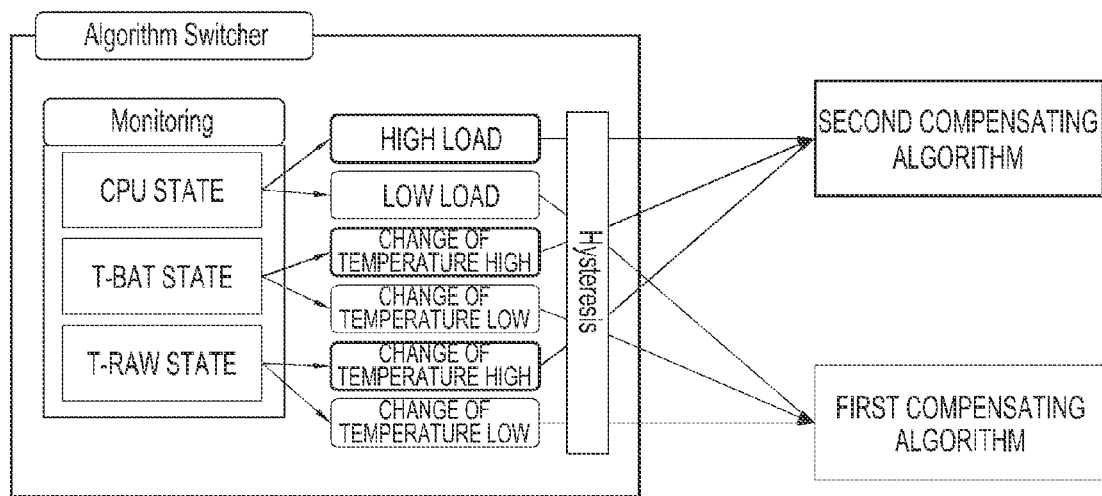


FIG. 7

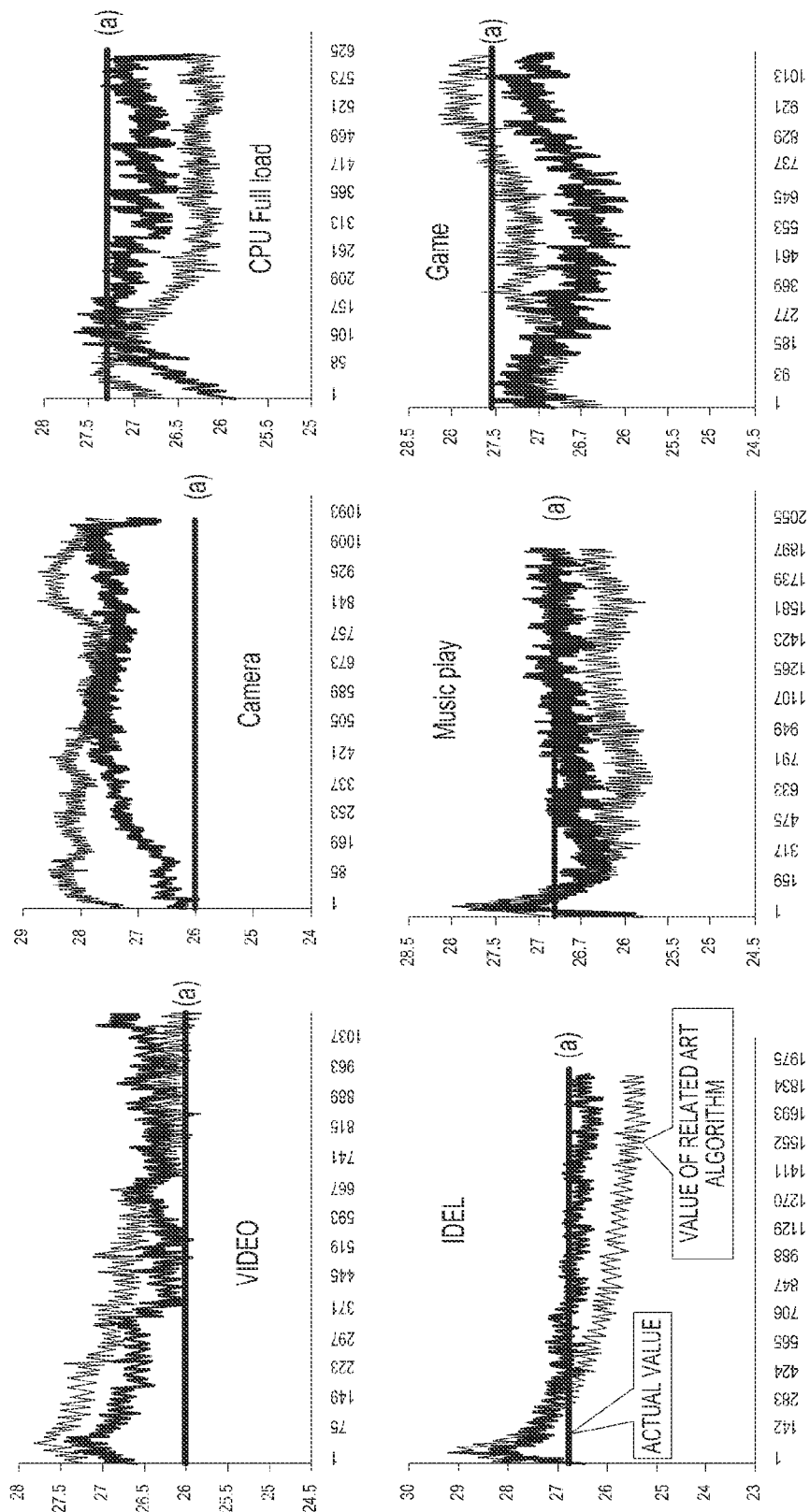


FIG. 8

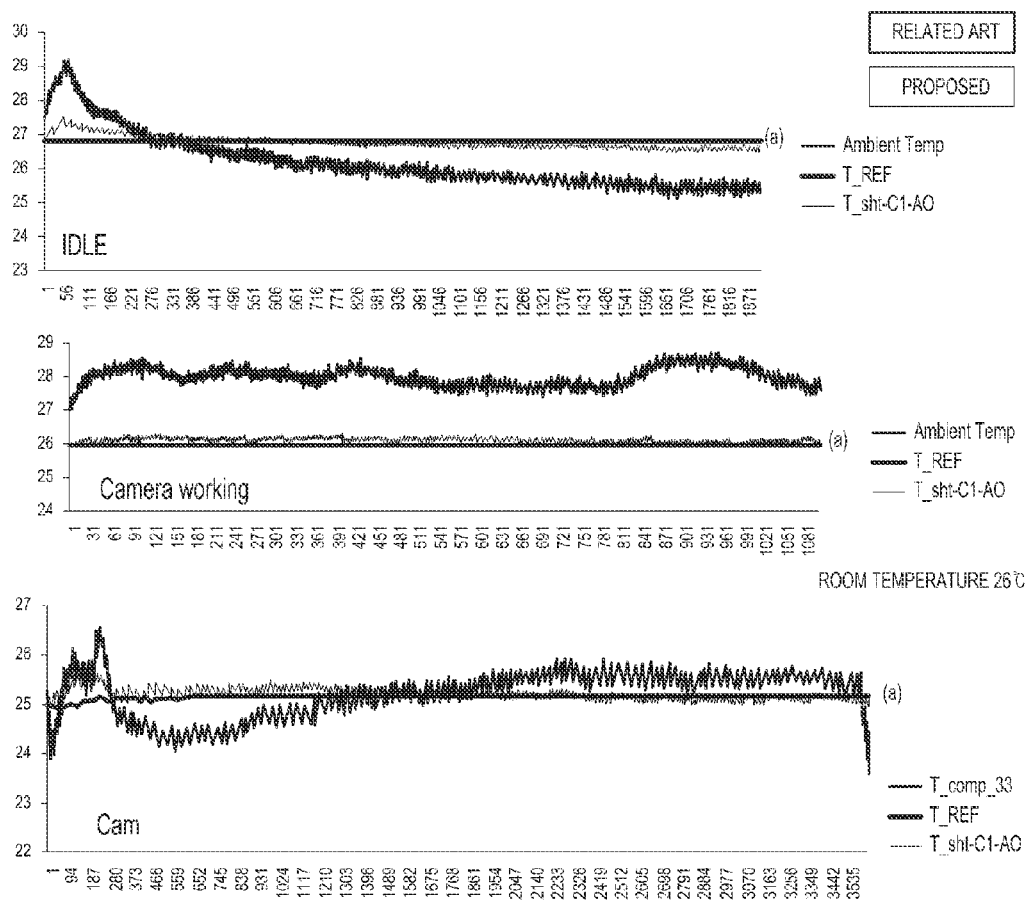


FIG.9

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METHOD FOR DETECTING ENVIRONMENTAL VALUE IN ELECTRONIC DEVICE AND ELECTRONIC DEVICE

CROSS-REFERENCE TO RELATED APPLICATION(S)

This application claims the benefit under 35 U.S.C. §119 (a) of a U.S. Provisional application filed on Mar. 14, 2013 in the U.S. Patent and Trademark Office and assigned Ser. No. 61/783,160, and under 35 U.S.C. §119(a) of a Korean patent application filed on Feb. 28, 2014 in the Korean Intellectual Property Office and assigned Serial number 10-2014-0024128, the entire disclosure of each of which is hereby incorporated by reference.

TECHNICAL FIELD

The present disclosure relates to an electronic device and a method of detecting an environmental value of the electronic device. More particularly, the present disclosure relates to an electronic device and a method of detecting an environmental value, which are capable of detecting an external environmental value and an approximated environmental value in the electronic device.

BACKGROUND

Mobile devices such as smartphones and tablet personal computers may have various sensors including sensors for measuring environmental values (e.g., a temperature value or a humidity value).

However, operations of the mobile devices may have an effect on precise measured values of the sensors. For example, heat generated during a high-speed operation of the mobile device may have an effect on a temperature sensor for measuring an environmental value in the mobile device.

The above information is presented as background information only to assist with an understanding of the present disclosure. No determination has been made, and no assertion is made, as to whether any of the above might be applicable as prior art with regard to the present disclosure.

SUMMARY

Aspects of the present disclosure are to address at least the above-mentioned problems and/or disadvantage and to provide at least the advantages described below. Accordingly, and an aspect of the present disclosure is to provide an electronic device and a method of detecting an environmental value of the electronic device, which are capable of detecting an external environmental value and an approximated environmental value in the electronic device.

In accordance with an aspect of the present disclosure, a method of detecting an environment value of an electronic device is provided. The method includes measuring a state of one or more units related to the electronic device, determining a value based at least in part on the measured state of the one or more units related to the electronic device, determining an operation state of the electronic device according to the value, and generating an approximated environment value according to the operation state.

In accordance with another aspect of the present disclosure, an electronic device is provided. The electronic device includes at least one sensor unit configured to measure a state of at least one unit related to the electronic device, and a controller configured to determine a value based at least in

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part on the measured state of the one or more units related to the electronic device, to determine an operation state of the electronic device according to the value, and to generate the approximated environment value according to the operation state.

In accordance with another aspect of the present disclosure, a method of determining a state of an electronic device is provided. The method includes iteratively measuring an operating temperature of one or more units of the electronic device, determining a current operation state of the electronic device according to a contemporaneous measured operating temperature of the one or more units of the electronic device, determining a temperature of a surrounding environment of the electronic device, and transitioning between at least a first operating state and a second operating state according to the contemporaneous measured operating temperature relative to a contemporaneous temperature of the surrounding environment.

The electronic device and the method of detecting the environmental value of the electronic device according to various embodiments of the present disclosure can detect the approximated environmental value in the electronic device.

Other aspects, advantages, and salient features of the disclosure will become apparent to those skilled in the art from the following detailed description, which, taken in conjunction with the annexed drawings, discloses various embodiments of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

The above and other aspects, features, and advantages of certain embodiments of the present disclosure will be more apparent from the following description taken in conjunction with the accompanying drawings, in which:

FIG. 1 is a block diagram illustrating a structure of an electronic device according to an embodiment of the present disclosure;

FIG. 2 is a graph illustrating a mutual relation of a temperature of a battery and an environmental value according to a state of an electronic device according to an embodiment of the present disclosure;

FIG. 3 is a graph illustrating a deviation of a temperature of a battery and an environmental value according to a state of an electronic device according to an embodiment of the present disclosure;

FIG. 4 is a graph illustrating a second compensating algorithm in an electronic device according to an embodiment of the present disclosure;

FIG. 5 is a flowchart illustrating a process of detecting an approximated environment value in an electronic device according to an embodiment of the present disclosure;

FIG. 6 is a flowchart illustrating a process of detecting an approximated environment value in an electronic device according to an embodiment of the present disclosure;

FIG. 7 is a view illustrating a discriminative application of an algorithm according to an environmental value and a state of an electronic device according to an embodiment of the present disclosure; and

FIGS. 8 and 9 are graphs illustrating a comparison and an analysis of environmental values obtained by applying a compensating algorithm according to various embodiments of the present disclosure and a compensating algorithm of the related art according to a state of an electronic device.

Throughout the drawings, it should be noted that like reference numbers are used to depict the same or similar elements, features, and structures

The following description with reference to the accompanying drawings is provided to assist in a comprehensive understanding of various embodiments of the present disclosure as defined by the claims and their equivalents. It includes various specific details to assist in that understanding but these are to be regarded as merely exemplary. Accordingly, those of ordinary skill in the art will recognize that various changes and modifications of the various embodiments described herein can be made without departing from the scope and spirit of the present disclosure. In addition, descriptions of well-known functions and constructions may be omitted for clarity and conciseness.

The terms and words used in the following description and claims are not limited to the bibliographical meanings, but, are merely used by the inventor to enable a clear and consistent understanding of the present disclosure. Accordingly, it should be apparent to those skilled in the art that the following description of various embodiments of the present disclosure is provided for illustration purpose only and not for the purpose of limiting the present disclosure as defined by the appended claims and their equivalents.

It is to be understood that the singular forms “a,” “an,” and “the” include plural referents unless the context clearly dictates otherwise. Thus, for example, reference to “a component surface” includes reference to one or more of such surfaces.

An electronic device according to various embodiments of the present disclosure may be a device having a communication function. For example, the electronic device according to the present disclosure may be one of a smart phone, a tablet Personal Computer (PC), a mobile phone, a video phone, an e-book reader, a desktop PC, a laptop computer, a netbook computer, a Personal Digital Assistant (PDA), a Portable Multimedia Player (PMP), a MP3 player, a mobile medical appliance, an electronic bracelet, an electronic necklace, an electronic appessory, a camera, a wearable device, an electronic clock, a wrist watch, home appliances including a refrigerator, an air conditioner, a cleaner, an oven, a microwave oven, a washing machine, an air cleaner, and the like, an artificial intelligence robot, a television, a Digital Video Disk (DVD) player, an audio player, various medical appliances including a Magnetic Resonance Angiography (MRA) device, a Magnetic Resonance Imaging (MRI) device, a Computerized Tomography (CT) device, an ultrasonography device and the like, a navigation device, a Global Positioning System (GPS) receiver, an Event Data Recorder (EDR), a Flight Data Recorder (FDR), a set-top box, a TV box such as HomeSync™ of SAMSUNG Electronics, Co., Apple TV™ of APPLE, Co., and Google TV™ of Google, Co., an electronic dictionary, an infotainment device for a vehicle, an electronic equipment for a ship such as a navigation device and a gyrocompass, an avionic device, a security device, an electronic cloth, an electronic key, a camcorder, a game console, a Head-Mounted Display (HMD) unit, a flat panel display device, an electronic frame, an electronic album, a furniture or a part of a building/structure having a communication function, an electronic board, an electronic signature receiving device, and a protector, or the like, or combinations thereof. It is obvious to a person skilled in the art that the electronic device according to the present disclosure is not limited to the above-mentioned devices.

FIG. 1 is a block diagram illustrating a structure of an electronic device according to an embodiment of the present disclosure.

FIG. 1 shows a network environment 100 including the electronic device 101 according to an embodiment of the present disclosure. Referring to FIG. 1, the electronic device 101 may include a bus 110, a controller 120, a memory 130, an input/output interface 140, a display 150, and a communication interface 160. According to various embodiments of the present disclosure, the electronic device 101 may include a sensor unit 170.

The bus 110 may be a circuit for connecting the above-mentioned structural elements to one another, and transferring communication (e.g., a control message), between the above-mentioned structural elements.

The controller 120, for example, may receive an instruction through the bus 110 from the above-structural elements (e.g., the memory 130, the input/output interface 140, the display 150, the communication interface 160 and the like), decode the received instruction, and execute a calculation or a data processing according to the decoded instruction.

The controller 120 may identify values obtained by measuring states of the structural elements according to the various embodiment of the present disclosure. The values obtained by measuring the states of the structural elements may include a temperature with relation to each internal structural element (e.g., the controller 120, the memory 130, the input/output interface 140, the display 150, the communication interface 160, the sensor unit 170, and/or the like of the electronic device 101). According to the various embodiments of the present disclosure, the state values of the structural elements may include a battery temperature T_BAT obtained by measuring a temperature of a battery (not shown), a controller temperature T_CPU obtained by measuring a temperature of a controller (e.g., a Central Processing Unit (CPU)), a communication interface temperature T_RF obtained by measuring a temperature of a communication interface 160, and a sensor temperature T_SENSOR obtained by measuring a temperature of a sensor 170.

The controller 120 may determine an operation state of the electronic device according to the values obtained by measuring the states of the structural elements and identified.

The controller 120 can calculate a difference of a state value (e.g., T_CPU) of a specific unit among the state values of the structural elements and an environmental measurement value T_RAW measured by a temperature/humidity sensor for measuring an external environmental temperature of the electronic device 101. The controller 120 determines the state of the specific unit as a first state if an absolute value of the difference is smaller than or equal to a second critical value C, and as a second state if the absolute value of the difference is larger than a second critical value C.

The controller 120 may compare the environmental measurement value T_RAW measured by the temperature/humidity sensor for measuring the external environment temperature of the electronic device 101 with a first predetermined critical value R according to various embodiments of the present disclosure. As a result, when the measured environmental value is smaller than or equal to the first critical value R, calculating a difference between the state value of the specific unit and the measured environmental value is possible. The controller 120 determines the state of the specific unit as a first state if the absolute value of the difference is smaller than or equal to the first critical value R, and as the second state if the absolute value of the difference is larger than the first critical value R.

The controller 120 may determine the state of the specific unit as the second state if the measured environmental value T_RAW is larger than the second critical value R in the electronic device 101.

According to the various embodiments of the present disclosure, the first state may include a standby state in which an application is not executed in the electronic device **101**, or a low load state of the controller (e.g., CPU). According to various embodiments of the present disclosure, the second state may include a high load state of the controller.

FIG. 2 is a graph illustrating a mutual relation of a battery temperature and an environmental value according to an embodiment of the present disclosure. FIG. 3 is a graph illustrating a deviation of a battery temperature and an environmental value according to a state of an electronic device according to an embodiment of the present disclosure.

Referring to FIG. 2, the graph illustrates that an environmental value (e.g., an external environmental temperature T_RAW), measured in the electronic device increases as a temperature T_BAT of a battery of the electronic device **101** rises. Further, according to the state of the electronic device **101**, there is a difference between an increment of the battery temperature T_BAT and an increment of the external environmental temperature T_RAW . The difference between an increment in the battery temperature T_BAT and the increment of the external environmental temperature T_RAW may vary according to a state of the electronic device **101**.

For example, according to the example illustrated in the graph of FIG. 2, if the controller has no load in an idling state in which an application is not executed, the increment ΔT_BAT of the battery temperature T_BAT and the increment ΔT_RAW of the external environment temperature T_RAW are substantially identical.

As another example, according to the example illustrated in the graph of FIG. 2, if an application for reproducing music with a low load of the controller is executed, a difference between the increment ΔT_BAT of the battery temperature T_BAT and the increment ΔT_RAW of the external environment temperature T_RAW is 0.2.

As another example, according to the example illustrated in the graph of FIG. 2, if a high-load application increasing a load of the controller is executed, a difference between the increment ΔT_BAT of the battery temperature T_BAT and the increment ΔT_RAW of the external environment temperature T_RAW is 1.1.

Referring to FIG. 3, in the standby state of the electronic device **101**, it is understood that a deviation of the battery temperature T_BAT and a measured environment value T_RAW is stably maintained when a deviation of the battery temperature T_BAT and an external environment value T_REF (e.g., an actual external environment value) is maintained.

Further, even if the electronic device **101** is in the state in which the controller has a low load, it is understood that the deviation of the battery temperature T_BAT and the measured environment value T_RAW is stably maintained even if the deviation of the battery temperature T_BAT and the measured environment value T_RAW increases.

According to the various embodiments of the present disclosure, therefore, the controller **120** detects an environmental value (e.g., an external environment temperature) approximated by applying a first compensating algorithm if the electronic device **101** is in a first state (e.g., a standby state or a low load state of the controller). According to the various embodiments of the present disclosure, the first compensating algorithm may be calculated by using Equation (1).

$$T_COMP = T_RAW - C2$$

Equation (1)

Herein, T_COMP corresponds to the approximated environmental value, T_RAW corresponds to the measured environmental value, and $C2$ corresponds to a predetermined value.

The $C2$ is the predetermined value for compensating a temperature value which constantly increases in the first state of the electronic device **101** (e.g., the standby state or the low load state of the controller).

According to various embodiments of the present disclosure, furthermore, the controller **120** detects an environmental value (e.g., an external environment temperature), approximated by applying a second compensating algorithm if the electronic device **101** is in a second state (e.g., a standby state or a high load state of the controller). According to the various embodiments of the present disclosure, the second compensating algorithm may be calculated by using Equation (2).

$$T_COMP = T_RAW - C1 * (T_STATE - T_RAW) - C2 \quad \text{Equation (2)}$$

Herein, T_COMP corresponds to the approximated environmental value, T_RAW corresponds to the measured environmental value, T_STATE corresponds to a state value of a specific unit, and $C1$ and $C2$ are predetermined values. The state value of the specific unit T_STATE comprises a battery temperature T_BAT , a controller temperature T_CPU , a communication interface temperature T_RF , and a sensor temperature T_SENSOR .

Hereinafter, according to various embodiments of the present invention, the state value of the specific unit T_STATE will be described by referring to (as an example of) the battery temperature T_BAT .

FIG. 4 is a graph illustrating a second compensating algorithm in an electronic device according to an embodiment of the present disclosure.

Referring to FIG. 4, if the environmental value T_RAW increases in the state of a high load controller as the battery temperature T_BAT increases, it is possible to detect an actual external temperature and an approximated environmental value (an external temperature) by applying the second compensating algorithm.

The memory **130** may store instructions or data which are received from the controller **120** or other structural elements (e.g., the input/output interface unit **140**, the display unit **150**, the communication interface unit **160**, and/or the like), or that are generated by the controller **120** or other structural elements. The memory **130** may include, for example, programming modules such as a kernel **131**, a middleware **132**, an Application Programming Interface (API) **133**, an application **134**, and the like. Each of the above-mentioned programming modules may include software, firmware, hardware, or combination of at least two thereof.

The kernel **131** may control or manage system resources (e.g., the bus **110**, the controller **120**, the memory **130**, and/or the like), used for executing an operation or a function implemented in other programming modules (e.g., the middleware **132**, the API **133**, the application **134**, and/or the like). Further, the kernel **131** may provide an interface through which the middleware **132**, the API **133**, the application **134**, and/or the like accesses and controls or manages an individual structural element of the electronic device **101**.

The middleware **132** may function as an intermediary so that the API **133** or the application **134** communicates with the kernel **131** to transmit and to receive data. Further, with relation to task requests received from the application **134**, the middleware **132** may perform a control for the task request (e.g., scheduling, load balancing, and/or the like) by using a method of assigning a priority to use the system resources of

the electronic device **101** (e.g., the bus **10**, the processor **120**, the memory **130**, and/or the like), to at least one of the applications **134**.

The API **133** is an interface for allowing the application **134** to control functions provided by the kernel **131**, the middleware **132**, and/or the like, and may include at least one interface or function (e.g., instruction), for a file control, a window control, an image processing control, a message control, and/or the like.

According to the various embodiments of the present disclosure, the application **134** may include a Short Message Service (SMS)/a Multimedia Messaging Service (MMS) application, an E-mail application, a calendar application, an alarm application, a health-care application (e.g., an application for measuring a quantity of motion, a blood sugar, and/or the like), an environment informing application (e.g., an application for providing information on an atmospheric pressure, a humidity, a temperature, and/or the like), an application for determining a context of the electronic device **101**, and/or the like. Additionally or alternatively, the application **134** may be an application relating to an exchange of information between the electronic device **101** and an external electronic device (e.g., an electronic device **104**). The application relating to the exchange of the information between the electronic device **101** and the external electronic device may include, for example, a notification relay application for transferring specific information to the external electronic device, a device management application for managing the external electronic device, and/or the like.

For example, the notification relay application may include a function of transferring notification information, which is provided by other applications (e.g., the SMS/MMS application, the E-mail application, the health-care application, the environment information application, and/or the like of the electronic device **101**), to the external electronic device (e.g., the electronic device **104**). Additionally or alternatively, the notification relay application, for example, may receive notification from the external electronic device (e.g., the electronic device **104**), and provide the notification to a user. The device management application, for example, may turn on/off some functions (e.g., external electronic device itself) or some structural parts, of the external electronic device (e.g., the electronic device **104**), adjust brightness (or resolution) of a display unit, and manage, install, delete or update services (e.g., a call service or a message service), provided by an application operating in the external electronic device or by the external electronic device.

According to the various embodiments of the present disclosure, the application **134** may include a designated application according to a property of the external electronic device **104** (e.g., a type of the electronic device). For example, if the external electronic device is an MP3 player, then the application **134** may include an application related to a reproduction of music. Similarly, if the external electronic device is a mobile medical appliance, then the application **134** may include an application related to a healthcare. According to various embodiments of the present disclosure, the application **134** may include at least one of an application designated for the electronic device **101** and an application received from the external electronic device (e.g., a server **106** or the electronic device **104**).

The input/output interface **140** may transmit an instruction or data input by a user through the input/output device (e.g., a sensor, a keyboard, a touch screen, and/or the like) to the controller **120**, the memory **130**, the communication interface **160**, and/or the like through the bus **120**. For example, the input/output interface **140** may provide data for a user's touch

input through a touch screen to the processor **120**. Further, the input/output interface **140** may output instructions or data, which are received through the bus **110** from the processor **120**, the memory **130**, the communication interface **160**, and/or the like through the input/output device (e.g., a speaker or a display unit). For example, the input/output interface **140** may output voice data, which is processed by the controller **120**, to the user through the speaker.

The display unit **150** may display various information (e.g. multimedia data, text data, a graphical user interface, and/or the like), to the user.

The communication interface **160** may connect communication between the electronic device **101** and the external device (e.g., the electronic device **104** and/or the server **106**). For example, the communication interface **160** may be connected to a network by wireless communication or wired-cable communication, so as to communicate with the external device. The wireless communication may include, for example, at least one of WiFi communication, Bluetooth communication, Near Field Communication (NFC), Global Positioning System (GPS), cellular communication (e.g., Long Term Evolution (LTE), Long Term Evolution-Advanced (LTE-A), Code Division Multiple Access (CDMA), Wideband Code Division Multiple Access (WCDMA), Universal Mobile Telecommunications System (UMTS), Wireless Broadband (WiBro) Global System for Mobile Communications (GSM), Infrared Data Association communication (IrDA), WiFi Direct, and/or the like. The wired-cable communication may include at least one of a Universal Serial Bus (USB), a High Definition Multimedia Interface (HDMI), a Recommended Standard 232 (RS-232), a Plain Old Telephone Service (POTS), and/or the like.

According to various embodiments of the present disclosure, the network **162** may be a telecommunication network. The communication network may include at least one of a computer network, an internet, an internet of things, a telephone network, and/or the like. According to various embodiments of the present disclosure, a protocol for communication of the electronic device **101** with the external device (e.g., a transport layer protocol, data link layer protocol, or a physical layer protocol), may be supported by at least one of the application **134**, the API **133**, the middleware **132**, the kernel **131**, the communication interface **160**, or the like.

The sensor **170** may measure at least one state related to the electronic device **101**. The sensor unit **170** measures a physical quantity, detects an operation state of the electronic device **101**, and converts measured or detected information into an electric signal. The sensor unit **170** may include, for example, at least one of a gesture sensor, a gyro sensor, an atmospheric pressure sensor, a magnetic sensor, an acceleration meter, a grip sensor, a proximity sensor, a color sensor (e.g., Red, Green, Blue (RGB) sensor), a living body sensor, a temperature/humidity sensor, an illuminance sensor, an ultraviolet sensor, and/or the like. Additionally or alternatively, the sensor unit **170** may include, for example, an E-nose sensor, an electromyography sensor, an electroencephalogram sensor, an electrocardiogram sensor, an infrared sensor, an eye-scanning sensor, a fingerprint-scanning sensor, and/or the like. The sensor unit **170** may further include a control circuit for controlling one or more sensors included therein.

An operation of detecting an actual environment value (an external temperature) and an approximated environment value (an external temperature) in the electronic device having the above-described structure will be described in detail with reference to FIGS. **5** and **6**.

Hereinafter, a temperature T_CPU of the controller and a temperature T_BAT of the battery will be described as an

example of at least one state value measured with relation to the electronic device to detect the external environment value (external temperature) and the approximated environment value (external temperature) in the various embodiments of the present disclosure. However, the state value is not limited to the temperature T_{CPU} of the controller and the temperature T_{BAT} of the battery.

FIG. 5 is a flowchart illustrating a process of detecting an approximated environment value in the electronic device according to an embodiment of the present disclosure.

Hereinafter, various embodiments of the present disclosure will be described with reference to FIG. 1 as follows.

Referring to FIG. 5, at operation 501, the controller 120 may receive an external temperature value T_{RAW} which is an environmental value measured by the temperature/humidity sensor included in the sensor unit 170 of the electronic device 101. According to various embodiments of the present disclosure, the controller 120 may operatively detect the external temperature value T_{RAW} using, for example, the sensor unit 170.

At operation 503, the controller 120 may receive a temperature T_{CPU} of the controller 120 and a temperature T_{BAT} of the battery respectively measured by the controller sensor and the battery sensor included in the sensor unit 170 of the electronic device 101. According to various embodiments of the present disclosure, the controller 120 may operatively detect the temperature T_{CPU} of the controller 120 and the temperature T_{BAT} of the battery using, for example, the sensor unit 170.

At operation 505, the controller 120 may calculate a difference between the measured environment value T_{RAW} and the temperature T_{CPU} of the controller 120, and compare an absolute value $|T_{CPU}-T_{RAW}|$ of the difference with a second critical value C which is predetermined. According to various embodiments of the present disclosure, the controller 120 may determine whether the electronic device 101 is in a first state, a high load state, and/or the like according to the calculated difference between the measured environment value T_{RAW} and the temperature T_{CPU} of the controller 120.

At operation 505, the controller 120 may determine that the electronic device 101 is in a first state (e.g., a standby state or a low load state of the controller) if the controller 120 determines that the absolute value $|T_{CPU}-T_{RAW}|$ of the difference is smaller than or equal to the second critical value C . If the controller 120 determines that the electronic device 101 is in the first state (e.g., if the controller 120 determines that the electronic device 101 is not in the high load state), then the controller 120 may proceed to operation 507.

At operation 507, the controller 120 may detect an external temperature and an environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying Equation (1) of the first compensating algorithm.

Alternatively, at operation 505, the controller 120 may determine that the electronic device 101 as a second state (e.g., a high load state of the controller) if the controller 120 determines that the absolute value $|T_{CPU}-T_{RAW}|$ of the difference is larger than the second critical value C . If the controller 120 determines that the electronic device 101 is in the second state (e.g., if the controller 120 determines that the electronic device 101 is in the high load state), then the controller 120 may proceed to operation 509.

At operation 509, the controller 120 may detect an external temperature and an environment value T_{COMP} approxi-

mated to the external temperature from the measured environment value T_{RAW} by applying Equation (2) of the second compensating algorithm.

According to various embodiments of the present disclosure, the controller 120 can monitor the absolute value $|T_{CPU}-T_{RAW}|$ of the difference. As the result of monitoring the absolute value $|T_{CPU}-T_{RAW}|$, if the controller 120 determines that the absolute value of the difference in the first state of the electronic device 101 is larger than the second critical value C , then the controller 120 may change the state of the electronic device 101 from the first state to the second state.

As the result of monitoring the absolute value $|T_{CPU}-T_{RAW}|$, if the controller 120 determines that the absolute value of the difference in the second state of the electronic device 101 is smaller than or equal to the second critical value C , then the controller 120 may change the state of the electronic device 101 from the second state to the first state.

FIG. 6 is a flowchart illustrating a process of detecting an approximated environment value in an electronic device according to an embodiment of the present disclosure.

Hereinafter, various embodiments of the present disclosure will be described with reference to FIG. 1 as follows.

Referring to FIG. 6, at operation 601, the controller 120 may receive an external temperature value T_{RAW} which is an environmental value measured by the temperature/humidity sensor included in the sensor unit 170 of the electronic device 101. According to various embodiments of the present disclosure, the controller 120 may operatively detect the external temperature value T_{RAW} using, for example, the sensor unit 170.

At operation 603, the controller 120 may receive a temperature T_{CPU} of the controller 120 and a temperature T_{BAT} of the battery, which are respectively measured by the controller sensor and the battery sensor included in the sensor unit 170 of the electronic device 101. According to various embodiments of the present disclosure, the controller 120 may operatively detect the temperature T_{CPU} of the controller 120 and the temperature T_{BAT} of the battery using, for example, the sensor unit 170.

Because accuracy of the first compensating algorithm may be lowered under sudden variation environment of temperature, comparing the measured environment value T_{RAW} and a first critical value R , the controller 120 may determine whether the measured environment value T_{RAW} is measured under a sudden variation environment of temperature.

Therefore, at operation 605, the controller 120 may compare the measured environment value T_{RAW} with a first critical value R . According to various embodiments of the present disclosure, the controller 120 may determine whether the measured environment value is within a range of the first critical value R (e.g., the controller 120 may determine whether $T_{RAW} \leq R$).

If the controller 120 determines that the measured environment value T_{RAW} is larger than the first critical value R at operation 605, the controller 120 determines that the measured environment value T_{RAW} is measured under a sudden variation environment of temperature and then the controller 120 may proceed to operation 611 at which the controller 120 may detect an environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying Equation (2) of the second compensating algorithm.

In contrast, if the controller 120 determines that the measured environment value T_{RAW} is smaller than or equal to the first critical value R at operation 605, then the controller 120 may proceed to operation 607 at which the controller 120

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may calculate a difference between the temperature T_{CPU} of the controller and the measured environment value, and compare the absolute value $|T_{CPU}-T_{RAW}|$ of the difference with the second critical value C . For example, at operation 607, the controller 120 may determine whether the electronic device 101 (e.g., the controller 120) is in a high load state.

At operation 607, the controller 120 may determine that the electronic device 101 is in a first state (e.g., a standby state or a low load state of the controller) if the controller 120 determines that the absolute value $|T_{CPU}-T_{RAW}|$ of the difference is smaller than or equal to the second critical value C . If the controller 120 determines that the electronic device 101 is in the first state (e.g., if the controller 120 determines that the electronic device 101 is not in the high load state), then the controller 120 may proceed to operation 609.

At operation 609, the controller 120 may detect an environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying Equation (1) of the first compensating algorithm.

Alternatively, at operation 607, the controller 120 may determine that the electronic device 101 is in a second state (e.g., a high load state of the controller) if the controller 120 determines that the absolute value $|T_{CPU}-T_{RAW}|$ of the difference is larger than the second critical value C . If the controller 120 determines that the electronic device 101 is in the second state (e.g., if the controller 120 determines that the electronic device 101 is in the high load state), then the controller 120 may proceed to operation 611.

At operation 611, the controller 120 may detect an environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying Equation (2) of the second compensating algorithm.

According to various embodiments of the present disclosure, the controller 120 can monitor the absolute value $|T_{CPU}-T_{RAW}|$ of the difference. As the result of monitoring the absolute value $|T_{CPU}-T_{RAW}|$, if the controller 120 determines that the absolute value of the difference in the first state of the electronic device 101 is larger than the second critical value C , then the controller 120 may change the state of the electronic device 101 from the first state to the second state.

As the result of monitoring the absolute value $|T_{CPU}-T_{RAW}|$, if the controller 120 determines that the absolute value of the difference in the second state of the electronic device 101 is smaller than or equal to the second critical value C , then the controller 120 may change the state of the electronic device 101 from the second state to the first state.

FIG. 7 is a view illustrating a discriminative application of an algorithm according to an environmental value and a state of an electronic device according to an embodiment of the present disclosure.

Referring to FIG. 7, the controller 120 may monitor the state of the controller, the temperature T_{BAT} of the battery and the measured environment value T_{RAW} by using the measured state value related to the electronic device 101. The controller 120 may detect the environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying the first compensating algorithm if the controller 120 determines that the controller is in a low load state. If the controller 120 determines that the controller is in a high load state, then the controller 120 may detect the environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying the second compensating algorithm.

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In contrast, the controller determines that a variation of the temperature is low when the temperature T_{BAT} of the battery is smaller than or equal to the predetermined critical value, and may detect an environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying the first compensating algorithm. In contrast, the controller determines that a variation of the temperature is high when the temperature T_{BAT} of the battery is larger than the predetermined critical value, and may detect an environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying the second compensating algorithm.

Alternatively, the controller 120 determines that a variation of the temperature is low when the measured environment value T_{RAW} is smaller than or equal to the first critical value R which is predetermined, and may detect the environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying the first compensating algorithm. Alternatively, the controller 120 determines that a variation of the temperature is high when the measured environment value T_{RAW} is larger than the first critical value R which is predetermined, and may detect the environment value T_{COMP} approximated to the external temperature from the measured environment value T_{RAW} by applying the second compensating algorithm.

FIGS. 8 and 9 are graphs illustrating a comparison and an analysis of environmental values obtained by applying a compensating algorithm according to various embodiments of the present disclosure and a compensating algorithm of the related art according to a state of an electronic device.

Referring to FIGS. 8 and 9, when the compensating algorithms according to various embodiments of the present disclosure and the related art are applied in the approximation of the environment value according to the state of the electronic device, it is understood that the environment value T_{COM} approximated by applying the compensating algorithm according to various embodiments of the present disclosure is approximated to the actual external temperature A .

The electronic device and the method of detecting the environment value of the electronic device according to the various embodiments of the present disclosure can be implemented as codes which are stored in a non-transitory computer-readable medium and read by a computer. The non-transitory computer-readable recording medium includes all the types of recording devices in which data readable by a computer system are stored. As for such a recording medium, for example, a Read Only Memory (ROM), a Random Access Memory (RAM), an optical disc, a magnetic tape, a floppy disc, a hard disc, or a non-volatile memory may be used, and a medium implemented in a type of carrier wave (e.g., transmission through the Internet) may also be included in such a recording medium. In addition, the computer-readable recording medium may be stored with codes which are distributed in computer systems connected by a network such that the codes can be read and executed by a computer in a distributed method.

While the present disclosure has been shown and described with reference to various embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present disclosure as defined by the appended claims and their equivalents.

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What is claimed is:

1. A method of detecting an environment value of an electronic device, the method comprising:

measuring a state of one or more units related to the electronic device;

determining a value based at least in part on the measured state of the one or more units related to the electronic device;

determining an operation state of the electronic device according to the value; and

generating an approximated environment value according to the operation state,

wherein the operation state of the electronic device includes a low load state of the one or more units related to the electronic device and a high load state of the one or more units related to the electronic device, and

wherein the determining of the operation state comprises: calculating a difference between a measured environment value and a state value of a specific unit among state values of one or more units.

2. The method of claim 1, wherein the determining of the operation state comprises:

determining that the electronic device is in a first state if an absolute of the difference is smaller than or equal to a second threshold value; and

determining that the electronic device is in a second state if the absolute of the difference is larger than the second threshold value.

3. The method of claim 2, further comprising:

calculating a difference between the measured environment value and the state value of the specific unit if the measured environment value is smaller than or equal to a first threshold value; and

determining that the electronic device is in the second state if the measured environment value is larger than the first threshold value.

4. The method of claim 1, wherein the generating of the approximated environment value comprises:

compensating for the approximated environment value by applying a first compensating algorithm if an operation state of the electronic device is a first state, the first compensating algorithm calculating the approximated environment value according to the following equation

$$T_COMP = T_RAW - C2$$

wherein, T_COMP is an approximated environmental value, T_RAW is a measured environmental value, and C2 is a predetermined value.

5. The method of claim 1, wherein the generating of the approximated environment value comprises:

compensating for the approximated environment value by applying a second compensating algorithm if an operation state of the electronic device is a second state, the second compensating algorithm calculating the approximated environment value according to the following equation

$$T_COMP = T_RAW - C1 * (T_STATE - T_RAW) - C2$$

wherein T_COMP is an approximated environmental value, T_RAW is a measured environmental value, T_STATE is a state value of a specific unit, and C1 and C2 are predetermined values.

6. The method of claim 2, wherein the first state includes at least one of a standby state in which an application is not executed, and a low load state of a Central Processing Unit (CPU), and

wherein the second state is a high load state of the CPU.

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7. The method of claim 2, wherein the determining of the value based at least in part on the measured state of the one or more units related to the electronic device comprises determining an average value of state values of plural specific units detected at a predetermined time period, and

wherein the measured environment value is determined by an average value of plural environment values detected by a predetermined time period.

8. The method of claim 2, further comprising:

monitoring the absolute value of the difference between a measured environmental value and a state value of a specific unit among state values of one or more units;

changing the electronic device from the first state to the second state if the absolute value is larger than the second threshold value; and

changing the electronic device from the second state to the first state if the absolute value is smaller than or equal to the second threshold value.

9. The method of claim 1, wherein the value determined based at least in part on the measured state of the one or more units related to the electronic device includes at least one of a temperature value of a battery, a temperature value of a Central Processing Unit (CPU), a temperature value of a communication processor chip, and a temperature value of a sensor unit.

10. An electronic device comprising:

at least one sensor unit configured to measure a state of at least one unit related to the electronic device; and

a controller configured to:

determine a value based at least in part on the measured state of the one or more units related to the electronic device,

determine an operation state of the electronic device according to the value, and

generate an approximated environment value according to the operation state,

wherein the operation state of the electronic device includes a low load state of the one or more units related to the electronic device and a high load state of the one or more units related to the electronic device, and

wherein the controller is further configured to:

calculate a difference between a measured environment value and a state value of a specific unit among state values of one or more units.

11. The electronic device of claim 10, wherein the controller is further configured to determine that the electronic device is in a first state if an absolute value of the difference is smaller than or equal to a second threshold value, and to determine that the electronic device is in a second state if the absolute value of the difference is larger than the second threshold value.

12. The electronic device of claim 11, wherein the controller is further configured to calculate a difference between the measured environment value and the state value of the specific unit if the controller determines that the measured environment value is smaller than or equal to a first threshold value in the electronic device, and to determine that the electronic device is in the second state if the measured environment value is larger than the first threshold value in the electronic device.

13. The electronic device of claim 10, wherein the controller is further configured to compensate for the approximated environment value by applying a first compensating algorithm if an operation state of the electronic device is a first state, and the first compensating algorithm calculates the approximated environment value by using the following equation

$$T_COMP = T_RAW - C2$$

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wherein T_COMP is an approximated environmental value, T_RAW is a measured environmental value, and C2 is a predetermined value.

14. The electronic device of claim 10, wherein the controller is further configured to compensate for the approximated environment value by applying a second compensating algorithm if an operation state is a second state, and the second compensating algorithm calculates the approximated environment value by using the following equation

$$T_COMP = T_RAW - C1 * (T_STATE - T_RAW) - C2$$

wherein T_COMP is an approximated environmental value, T_RAW is a measured environmental value, T_STATE is a state value of a specific unit, and C1 and C2 are predetermined values.

15. The electronic device of claim 11, wherein the first state includes at least one of a standby state in which an application is not executed, and a low load state of a Central Processing Unit (CPU), and

wherein the second state is a high load state of the CPU.

16. The electronic device of claim 11, wherein the controller is further configured to determine the value based at least in part on the measured state of the one or more units related

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to the electronic device by determining an average value of state values of plural specific units detected at a predetermined time period, and to determine the measured environment value by an average value of plural environment values detected by a predetermined time period.

17. The electronic device of claim 11, wherein the controller is further configured to monitor the absolute value of the difference between a measured environmental value and a state value of a specific unit among state values of one or more units, to change the electronic device from the first state to the second state if the absolute value is larger than the second threshold value, and changes the electronic device from the second state to the first state if the absolute value is smaller than or equal to the second threshold value.

18. The electronic device of claim 10, wherein the value determined based at least in part on the measured state of the one or more units related to the electronic device includes at least one of a temperature value of a battery, a temperature value of a Central Processing Unit (CPU), a temperature value of a communication processor chip, and a temperature value of a sensor.

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